ES&S InkaVote Precinct Ballot Counter
VOLUME TEST – April 14, 2006
Supplemental OVSTA Staff Report

Introduction

Election Systems & Software, Inc. (ES&S), in partnership with International Lottery and Totalizator Systems, Inc. (ILTS), has applied for certification of their InkaVote voting system comprised of the Unisyn Voting Solution Election Management System software, version 1.1, and the InkaVote Precinct Ballot Counter (PBC), version 1.10.

The normal State examination and testing of that system was conducted in Carlsbad, California, from January 23rd through January 27th, 2006. Because the vendor could not supply the required number of PBC devices at that time, a modified "pre-volume" test was conducted in Carlsbad on January 27th. This test involved five PBC units and was loosely based on the established State protocol for volume testing. That test and its results are described in detail in the Staff Report on this system, dated February 22nd, 2006.

The vendor subsequently advised us that the required number of machines would be available for volume testing after April 3rd, 2006. On April 14th, the volume test of the InkaVote PBCs was conducted in Garden Grove, California. This report details the methodology employed for that test as well as the results from the test.

Volume Testing Conduct

The Secretary of State staff and technical consultants Paul Craft and Kathleen McGregor conducted the volume test of the InkaVote PBC on April 14th, 2006, at the Hyatt Regency Orange County in Garden Grove, California.

Fifty InkaVote PBCs were tested between 8:50am and 4:15pm that day. Ten pre-marked test decks were used, each based on the standard test primary election specified for voting system testing in California. A trusted version of the PBC firmware was installed on five randomly selected PBC units under the direct observation of the technical consultants.

The volume tests were conducted in accordance with the Secretary of State's standard protocol for volume testing. (This protocol may be obtained from the Secretary of State website at: http://www.ss.ca.gov/elections/elections_vs.htm) Six temporary contract workers were hired by the Secretary of State to perform the testing, acting as "voters." Additionally, three members of the Secretary of State staff performed test voting as well. All testing was directly observed by Secretary of State staff. Finally, the overall testing environment was recorded continuously on videotape.

All errors were documented, whether they were attributed to the equipment or to human performance. At the discretion of the test director, specific errors were documented with either photographs or videotape, or both. Generally, successive errors of the same type were not documented in such detail once their initial instances had been captured.

Volume Testing Results

A total of twenty-nine incidents were logged during the PBC volume test. Of those, only seven were attributed to performance of the equipment. Nineteen of the logged incidents were attributed to human errors that were artifacts of the testing process. Finally, three of the logged incidents were not actual errors of the system, but were documentation of events that happened during the testing.

In one instance, a ballot was fed into the PBC and jammed internally. When the vendor staff started to disassemble the PBC to remove the stuck ballot, the ballot spontaneously ejected. The ballot was subsequently reinserted into the PBC and correctly read. Should this have happened in a polling place on Election Day, the poll workers would need to use the auxiliary slot in the ballot box to store all voted ballots until a technician could arrive and restore the PBC to operating condition or replace the PBC.

There were six instances where a ballot was initially refused and returned to the voter. In at least three of those instances, the PBC printed the error message "Invalid Ballot". In all instances, the ballot was ultimately accepted and read when reinserted, although in one case it took approximately twelve to fifteen reinsertion attempts before the ballot was successfully read.

Of the nineteen logged incidents attributed to human error, eighteen of these were notations that the public counter indicated a different number of ballots scanned than were predicted by the test deck. For the majority of these cases, the test deck was physically counted to verify the correct number of ballots that should have been tallied. In a couple of cases, it was determined that ballots had inadvertently transferred from one test deck to another through mishandling. In the majority of these cases, it was determined that these errors were caused by the voter inadvertently feeding two ballots simultaneously into the PBC because they had gotten stuck together. In these cases, only the top ballot would be read. The technical consultants made this determination from:

- direct observation of the "voters'" behavior;

- analysis of the distribution of 'missing ballots' – *two of the voters in particular had a much higher rate of missing ballots than the remaining testers*; and

- analysis of the actual vote results – *in each instance, a specific ballot could be identified that, if not scanned, fully explained the discrepancies.*

Double-feeding of ballots would not occur in an actual polling place on Election Day, since voters are only provided one ballot. However, the vendor proposes that the InkaVote PBC also be used to read absentee ballots and tally their results. If used in such a manner, there is a possibility that the problem of double-feeding ballots could occur. In the short term, the vendor must specify procedures to prevent this from happening. Use Procedures, such as limiting the batch size and careful ballot accounting, should resolve this issue. In future versions of the system, this error should be addressed through technology that actually detects and prevents double-feeding of ballots.

The remaining incident attributed to human error was determined to likely be the result of confusion on the part of the test 'voter'. The PBCs were initialized to read ballots for one precinct. As ballots were added from additional precincts, those precincts were

initialized by feeding a ballot from the new precinct into the PBC and having it rejected. A "poll worker" would then authorize the PBC to count that precinct by entering an administrative password, and triggering the PBC to print a zero tape for that new precinct. After the zero tape was printed, the PBC would prompt the user to reinsert the ballot so that it could be scanned and counted. In one instance, the voter thought the ballot had been automatically read after initializing. Careful questioning of the voter discovered some confusion over the exact sequence of events. Further, at the end of the test, the vote results of that machine were reviewed and found to exactly match the predicted results for that test deck.

Three incidents logged were actually just documentation of events that occurred during testing:

- In one instance, a staff member tripped over a power cord and inadvertently shut off the power to two of the PBCs. Once electricity was restored, the two PBCs were rebooted and gracefully recovered from the power loss, resuming normal voting with no votes lost.

- At power-up, it was discovered that one of the PBCs was low on paper. To resolve this, a new roll of paper was inserted in accordance with the system Use Procedures.

- In one instance, the vendor staff inadvertently assigned the wrong test deck to a PBC. The expected results for that machine were updated to reflect the new test deck and that test deck was successfully processed and verified.

The error log and all incident reports are included as an appendix to this report.

Reconciliation of Vote Results

At the conclusion of the volume test, a results tape was printed from each PBC and compared against the expected results. For thirty-five PBCs those results perfectly matched the expected results.

One test deck (deck #5) was found to have an incorrectly marked ballot. Once the expected results for that deck were updated to reflect the actual test deck, the five machines on which that deck were used all reconciled perfectly. (PBCs #10, 20, 30, 40 & 50).

In a second case, there was a machine that incorrectly reported the results for one candidate in one contest. An inspection of the test deck found a ballot that had been improperly cut and had a marginal marking for that voting position (e.g., the voting target was approximately 25% filled). The defective ballot was retained as part of the test documentation.

On the remaining fourteen PBCs, the vote results varied from the expected results by complete ballots. As discussed in the previous section, these were attributed to either ballots transfer between test decks or double-feeding of ballots. In each instance, exact ballots could be identified that fully explained the discrepancies. Over 80% of the discrepancies were attributed to two of the test 'voters.' The remaining 19% of the discrepancies were evenly divided among the remaining seven test 'voters.'

Conclusion

There was nothing found in the volume test of the InkaVote PBC to suggest this system should not be approved for use in California. As noted in the report, the vendor must address the issue of potential double-feeding absentee ballots in the Use Procedures for this system in the short-term, and should resolve this problem with technological means in future versions of the system.

APPENDIX A
INKAVOTE PBC VOLUME TEST
SUMMARY OF INCIDENT REPORTS

Incident #	Time	Machine #	Ballot #	Incident Report	Photos	Video	Error	Voter	Critical (Vote Record Lost)	No Error	Machine Error	Human Error	Defective ballot	Out of paper. Replenished paper.	Wrong test deck used.	Power cut off. Recovered gracefully.	Ballot jam - Cleared itself after removing printer.	Ballot feed issues	Ballot count off	Voter confusion
1	8:55	8	21	X	X	X	Ballot not initially accepted. ("Invalid Ballot") Removed and successfully reinserted ballot.	Veronica			1							1		
2	9:25	6	281	X			Public counter short 1 ballot	Robert				1							1	
3	9:44	3	438	x			Public counter short 1 ballot	Elicia				1							1	
4	9:45	5	437	X			Public counter short 2 ballots	Clare				1							1	
5	10:00	13 & 11	2, 0	X			Test staff accidentally turned off power bar & shut down 2 PBCs. Both recovered gracefully when power restored.			1						1				
6	10:23	12	158	X			Public counter over 1 ballot.	Veronica				1							1	
7	10:28	11	145	X	X	X	Ballot hung in intake. Removed and successfully reinserted ballot.	Clare			1							1		
8	10:26	14	156	X			Public counter short 1 ballot	Betty				1							1	
9	10:39	11	162	X			Ballot hung in intake. Removed and successfully reinserted ballot.	Clare			1							1		
10	10:53	18	0	X			PBC low on paper. Paper replaced	Orlando		1				1						
11	10:55	9	321			X	Ballot stuck. Removed printer and ballot spontaneously ejected. Successfully reinserted.	Kevin			1					1			
12	11:00	14	0	X			Machine assigned wrong test deck. (All ballots fed successfully.)	Betty		1					1					
13	10:56	13	283	X			Public counter over 1 ballot.	Elicia				1							1	
14	10:39	11	266	X			Machine won't accept ballot. Successfully reinserted after 12-15 attempts	Clair			1							1		
15	11:13	9	438	X			Public counter short 1 ballot	Kevin				1							1	
16	11:17	15	362	X			Ballot not initially accepted. ("Invalid Ballot") Removed and successfully reinserted ballot.	Robert			1							1		
17	11:28	15	406	X			Public counter short 1 ballot	Robert				1							1	
18	11:31	13	440	X			Public counter over 2 ballots.	Elicia				1							1	
19	11:05	20	121	X			Public counter over 3 ballots. (found ballots shifted within deck)	Kevin				1							1	
20	11:10	22	126	X			While initializing PBC to accept pct 4, voter reports PBC simultaneously read ballot	Orlando				1								1
21	1:11	30	124	X			Public counter short 1 ballot	Betty				1							1	
22	12:50	31	155	X			Public counter short 2 ballots	Clare				1							1	
23	1:36	31	435	X			Public counter short 4 ballots	Clare				1							1	
24	2:55	37	155	X			Public counter short 2 ballots	Clare				1							1	
25	3:09	37	277	X			Public counter short 5 ballots	Clare				1							1	
26	3:26	37	432	X			Public counter short 7 ballots	Clare				1							1	
27	3:28	44	146	X			Ballot not initially accepted. ("Invalid Ballot") Removed and successfully reinserted ballot.	Elicia			1							1		
28	3:46	47	281	X			Public counter short 1 ballot	Paul				1							1	
29	3:50	46	280	X			Public counter short 2 ballots	Betty				1							1	

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							TOTALS		0	3	7	19	0	1	1	1	1	6	18	1
											29								29	

Machines with Errors: Count = 5 *(8, 9, 11, 15, 44)*

Ballot Jam
- On one occasion (incident #11), the ballot got stuck inside the PBC. When the vendor staff removed the printer from the PBC and prepared to open the scanner assembly, the ballot spontaneously ejected. After reattaching the printer, the ballot was successfully reinserted and scanned. The vendor could identify no apparent reason for the ballot jamming, or spontaneously ejecting.

Ballot Feed Problems
- On six occasions (incidents #1, 7. 9, 14, 16, 27) the ballot was not accepted. On at least three of those occasions, the PBC displayed the error message "Invalid Ballot." For all six incidents, the ballot was removed, reinserted and successfully read. (For incident #14, the ballot had to be reinserted approximately 12 - 15 times before it was successfully scanned.)

Ballot Count Off
- In eighteen instances, the PBC ballot counter was off by one or more ballots from the expected results. For many of these, the test deck was immediately pulled and the correct number of ballots verified. Based on testing and observation of the test "voters", the State's Technical Consultants and the OVSTA Staff believe the count discrepancies can be attributed to the voters feeding to the PBC simultaneously two ballots that were stuck together, In this case the second ballot would not be accurately read. Additionally, there were instances noted where one ballot card was mistakenly transferred from one test deck to another, causing the decks themselves to be over and under.

Voter Confusion
- On one occasion (incident #20), the voter reported that when he used a ballot to initiallize a PBC for a new precinct, the PBC also accepted and scanned the ballot. (Normal, expected behavior is for the PBC to scan and reject the ballot, initialize the precinct, and then count the ballot when it is reinserted.) After questioning the test "voter" at length, the Technical Consultant and OVSTA staff believe the voter was confused over the exact sequence of events. In any event, the ballot was accurately scanned and recorded.

Non-Error
Incident Reports were written to document three events that were not actually errors of the system or the test participants.
- The first (incident #5), occurred when OVSTA staffed tripped over a power cord and disconnected the power to two PBCs. Both PBCs were immediately powered back up and recovered gracefully from the interruption of power. Test voting was then successfully resumed.
- At power-up (incident #10), it was determined one PBC was low on paper. A fresh roll of paper was then inserted according to procedures.
- For one machine, the test 'librarian' assigned the wrong test deck to be used for that machine. (incident #12) To compensate, the expected vote results for that machine were altered accordingly.

APPENDIX B
INKAVOTE PBC VOLUME TEST
RECONCILIATION OF VOTE RESULTS

Machine Number	'Voter'	Vote Count Balanced	Vote Count Off	Ballot Count	Discrepancy Explanation
1	Betty		X	Short 3 ballots	**Pct 1 short 1 LIB ballot:** Pres-Russo. Sen-Lightfoot, CG49-W/I, SS35-W/I, AD66-W/I, LG Mayor-England, LG Council-Greer & Jones, Prop 42-No **Pct 2 short 1 LIB ballot:** Pres-Russo, Sen-W/I, undervote all others **Pct 2 short 1 REP ballot:** Sen-W/I, undervote all others
2	Kevin		X	Short 1 ballot	**Pct 3 short 1 NP ballot:** Prop 42-No
3	Elicia	X			
4	Orlando	X			
5	Clare		X	Short 2 ballots	**Pct 1 short 1 ballot:** LG Mayor- W/I, undervote all others **Pct 2 short 1 REP ballot:** Pres-W/I, Sen-Marin, CG-49-W/I, SS37-W/I, AD74-W/I, Prop42-No
6	Robert		X	Short 1 ballot	**Pct 4 short 1 REP ballot:** Sen-Kaloogian, AD76- W/I, PVU Distr-Simpson, undervote all others
7	Ryan	X			
8	Veronica	X			
9	Kevin	X			
10	Orlando	X			
11	Clare	X			
12	Veronica	X			
13	Elicia		X	Over 1 ballot	**Pct 1 over 1 NL ballot:** overvoted all contests
14	Betty		X	Short 1 ballot	**Pct 1 short 1 ballot:** LG Mayor- Luna, LG Council- Lake & W/I, undervote all others **Pct 2 short 1 DEM ballot:** Pres-W/I, undervote all others **Pct 2 short 1 GRN ballot:** Pres-Salzman, Prop 42-Yes, undervote all others
15	Robert	X			Review of the zero-tapes and results clearly prove that Precinct 2-1 was mistakenly run twice, rather than Pct 2-1 once and Pct 2-2 once. Vote results, thus, reconcile correctly
16	Paul	X			
17	Elicia	X			
18	Orlando	X			
19	Betty		X	Short 1 ballot	**Pct 1 short 1 ballot:** Ballot entirely blank or overvoted
20	Kevin	X			
21	Robert	X			
22	Orlando	X			
23	Clare	X			
24	Elicia	X			
25	Paul	X			
26	Veronica	X			
27	Robert		X		**Pct 2 off one vote CV Council contest:** Examination of the ballot indicated ballot was improperly cut and the mark for that voting position was marginal (only filled approx. 25% of target.)
28	Kevin	X			

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Machine Number	'Voter'	Vote Count Balanced	Vote Count Off	Ballot Count	Discrepancy Explanation
29	Orlando	X			
30	Betty	X			
31	Clare		X	Short 4 ballots	**Pct 1 short 1 GRN ballot:** Pres-W/I, undervote all others **Pct 1 short 1 REP ballot:** Pres-W/I, Sen-Jones, CG49-W/I, SS35-Maddox, AD66-Haynes, LG Mayor- England, LG Council- Greer & Jones, Prop 42-No **Pct 2 short 1 LIB ballot:** Pres-Badnarik, Sen-W/I, undervote all others **Pct 2 short 1 BLANK or OVERVOTED ballot.**
32	Kevin	X			
33	Veronica	X			
34	Kevin	X			
35	Elicia	X			
36	Orlando	X			
37	Clare		X	Short 7 ballots	**Pct 1 short 1 DEM ballot:** Pres-Edwards, Sen-W/I, CG49-W/I, SS35-W/I, AD66-Canfield, LG Mayor-England, LG Council-Greer & Jones, Prop 42-No **Pct 1 short 1 NP ballot:** LG Mayor-Luna, LG Council-Lake & W/I, undervote all others **Pct 2 short 1 DEM ballot:** Pres-Dean, undervote all others **Pct 2 short 1 PF ballot:** Pres-W/I, undervote all others **Pct 2 short 1 REP ballot:** Sen-Kaloogian, undervote all others **Pct 2 short 1 NP ballot:** CV Mayor-Salas, CV Council-Pina **Pct 2 short 1 ballot:** CV Mayor-W/I, CV Council-W/I
38	Robert	X			
39	Betty	X			
40	Paul	X			
41	Kevin	X			
42	Veronica	X			
43	Orlando		X	Short 1 ballot	**Pct 2 short one blank or overvoted ballot**
44	Elicia	X			
45	Robert	X			
46	Betty		X	Short 2 ballots	**Pct 3 short 1 GRN ballot:** Pres-W/I, undervote all others **Pct 4 short 1 blank or overvoted ballot**
47	Paul		X	Short 1 ballot	**Pct 2 short 1 NL ballot:** Sen-W/I, Prop 42-No
48	Kevin		X	Short 1 ballot	**Pct 4 short 1 Rep ballot:** Sen-W/I, undervote all others
49	Clare		X	Short 1 ballot	**Pct 2 short 1 NP ballot:** CV Mayor-W/I, CV Council-W/I
50	Orlando	X			
TOTALS		**35**	**15**		

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Machine Number	'Voter'	Vote Count Balanced	Vote Count Off	Ballot Count	Discrepancy Explanation

Ballots Short - By Voter

Voter	PBCs voted	Ballots Short	Average Short/PBC	
Betty	6	7	1.2	27%
Clare	6	14	2.3	54%
Elicia	6		-	0%
Kevin	8	2	0.3	8%
Orlando	8	1	0.1	4%
Paul	4	1	0.3	4%
Robert	6	1	0.2	4%
Ryan	1	0	-	0%
Veronica	5	0	-	0%
Totals	*50*	*26*	0.5	